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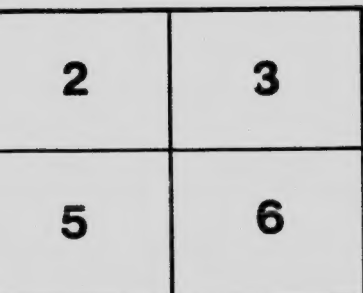
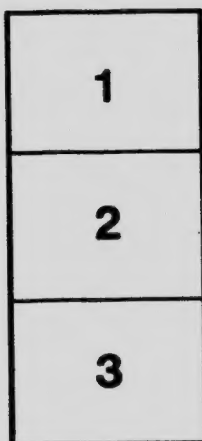
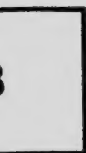
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British Columbia Dairymen's Association.

THE HIGH COST OF BACTERIA.

A Lecture delivered at the Annual Convention of the B.C.D.A., Hotel Vancouver, January 21st, 1920.

BY PROFESSOR WILFRID SADLER, DEPARTMENT OF DAIRYING, UNIVERSITY OF BRITISH COLUMBIA.

[REPRINTED FROM THE AGRICULTURAL JOURNAL OF B.C.]



MY discussion with you is to be primarily concerned with milk and milk products. It is not my purpose to deal with the question of milk as a food. Professor Washburn, who will speak to-night, is more competent to deal with that phase of the question than am I. All I will say is this: The necessity for including milk in the diet, especially in the diet of the young, and particularly of the infant, has been established beyond any possible doubt. The dramatic investigations of Hopkins, of McCollum, and of other workers have irrefutably demonstrated that not only is milk necessary as a food, but that it is positively essential on account of the growth-promoting substance therein contained.

To-day we hear much with regard to the high cost of living. I am not an economist, and am therefore not competent to submit observations on this important question. It is a truism so obvious that possibly I should apologize to you for venturing to present it, that one of the basic factors responsible for the high cost of living is lack of production. We must have increased production, and then conservation of that which has been produced. Lack of conservation constitutes waste and spoilage. Waste and spoilage in milk and milk products are principally due to the activities of the bacteria. Waste and spoilage are principally due to the failure to exercise the proper control over the bacterial population of these products. The nature of our loss and the amount of our loss due to spoilage are what we pay for our bacteria—the high cost of bacteria.

I am quite sure that it is not necessary to take your time in dealing with the bacteria in the specific sense. As cultivators and culturists of the soil, you are so well aware of the part which the bacteria play in all the processes of nature that it would be not complimentary on my part to impose upon you a detailed discussion. The point that we are concerned with is the fact that, while these organisms are so small, these single-celled plants are so minute that they have to be multiplied at least 1,000 times before they can be seen at all under the microscope, their rapidity of multiplication is such that they constitute a factor of the most vital importance.

For a number of years the literature has contained references to the association of milk with certain specific diseases—with tuberculosis, typhoid fever, diphtheria, septic sore throat, and so on. With us the number of instances in which these diseases have actually resulted from the milk-supply is comparatively rare. Provided the cattle are healthy—and in this respect no Province in the Dominion is in such a happy position as is our own—it must be remembered that, if outbreaks of the diseases cited above do occur, milk is simply a "carrier"; and it cannot be emphasized too much that such contamination arrives during, or subsequent to, production.

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intimately
We are ~~intimately~~ concerned with the relationship of milk to what is often called infantile diarrhoea, or summer diseases of children. Some years ago I was associated with Dr. Harrison and Dr. Savage in conducting a bacteriological investigation into the milk-supply of the City of Montreal. We examined a great number of samples from the various parts of the Province, representative of the dairies supplying the City of Montreal. At that time the death-rate of infants under one or two years of age in the City of Montreal was equalled only by the death-rate of infants of similar age in Chile; thirty-two out of every hundred at this age died, due largely to diseases of an intestinal nature. These cases were partly and possibly largely due to contaminated milk; but I wish to tell you that as a result of that work the conditions in Montreal are entirely changed. Further, several years ago the City of New York had a death-rate of children under five years of age equal to 96.2 per thousand births. Thirteen years later the death-rate per thousand had fallen to fifty-five, largely due to the introduction by Nathan Strauss of the sale of pasteurized milk. It is highly desirable at this point to emphasize emphatically that in cases where questionable milk is suspected of causing intestinal troubles, and a change of milk or pasteurization of milk bring about a better state of affairs, this better state of affairs is due to some extent to the fact that once a mother is interested in controlling and caring for her milk she becomes in the truest sense a hygienist. And it is probable that the quickest way to institute a sane appreciation of the general hygiene of living is through a campaign for hygienic milk. The bacteria associated with these troubles are principally the organisms coming from intestinal sources.

We have already stated that, provided the cattle are healthy, all bacterial contamination arrives during or subsequent to the production of the milk. There are certain organisms in the udder of the normally healthy cow, but they are to a very great extent innocuous. Hence the presence of bacteria is preventable. Thus the cost of community loss in child-life, the fear of drinking milk on account of possible troubles to follow and the consequent lack of nourishment to the child on this account, further loss of child-life because of the lack of necessary milk, loss of prestige to the purveyor, loss of customers, and loss of income constitute what the country, the community, and the dairyman pay for the bacteria—the high cost of bacteria.

Fears have been expressed in some quarters regarding the Fraser Valley Farmers' Association movement in respect to the supply of milk to the City of Vancouver. I have no fears at all in this direction. I am confident that in a very few years' time the situation as it exists to-day will in its development bring with it such conditions as will result in Vancouver receiving a supply of milk second to none on this continent. With the organization indicated, all of you concerned financially, as well as morally, in its welfare, you are gradually going to bring about conditions associated with the production and distribution of milk such as could never have been possible under other circumstances. You will now all subscribe to the common welfare of the association, and you are all involved in the moral responsibility to the consumer. Through his pocket each member will be educated to produce a hygienic milk.

Let us return to wastage. We have said that wastage and spoilage are primarily due to lack of control and to mismanagement of the bacterial population of the milk and its products. We have said—with specific qualifications—that the presence of bacteria is preventable. In the State of New York some two or three years ago milk and cream valued at \$2,600,000 had to be returned to the suppliers by one creamery alone. Why? Because it was sour and spoiled. It was wasted, it was thrown back on the producer, and no returns were available. During the war the Dairy Research Station at Reading, England, was asked by the Government to inquire as to the losses of milk due to spoilage. The milk from two districts, producing 90,000,000 gallons and 75,000,000 gallons respectively, was investigated. By the time the milk reached the city 1 per cent of it was not available for consumption by the consumer. It had spoiled or soured. At current prices that loss is computed at \$7,000,000. There is the loss in money, loss in terms of food, and loss of food for which there is no substitute. The sums of \$2,600,000 and \$7,000,000 respectively are what the farmers and the community have paid for their bacteria—surely a high price to pay. In the work done on the Montreal milk-supply by Harrison, Savage, and Sadler, we found

that out of 900 samples some 600 samples represented milk which could not have been sold in New York, Boston, or Chicago on account of the high bacterial content. In other words, had the law in Montreal been the law in existence in the cities mentioned, the milk represented by 600 of the 900 samples we took would have been totally lost to the community; and that loss would have been the price paid for the bacteria—the high cost of bacteria. The farmer pays it; the consumer pays it; the community pays it; the country pays it.

The experiments conducted by Dr. North, of the North Laboratories, New York, have confirmed the postulate that 95 per cent. of the success or non-success in fighting the high cost of bacteria is the man engaged in the business.

As you know, certified milk is milk produced from herds free from disease on the authority of a veterinarian, managed and handled by people subject to medical inspection, and produced and handled under such conditions as are authorized by a medical commission. Such milk is to contain not more than 10,000 bacteria per c.c. at the time of sale in the summer, and not more than 5,000 bacteria per c.c. at the time of sale in the winter. And it is possible, under ordinary conditions, with the greatest care, to produce milk with a content almost as low.

TWO TYPES OF COMMERCIAL MILK

FREEAR, BUCKLEY AND WILLIAMS

READING, ENGLAND

FARMS CERTIFIED MILK CONDITIONS

AGE	ON ARRIVAL IN LAB	22 TO 26 HOURS	
TEMP	"	40 " 70 F.	
		60 " 68 F.	1.75 - 6.75 DAYS
NO CLOT AT		56 " 59 F.	1.75 - 18.25 "
		ICE CHEST	7.75 - 32.75 "
BACTERIA		71 " 73	10000 UNLESS PEN CC
TOTAL		38 " 73	500 " "
COLON		8 " 73	LACTOSE POS

The charts here shown demonstrate the relationship of the bacterial content of milk to the length of period of usability of the milk. It will thus be seen readily that diminution of period of usability is the price paid for the bacteria. Further, the effect of temperature on the rate of growth of bacteria and on the comparative rate of growth of the different varieties of bacteria is a factor of the utmost importance. At the higher temperature the bacterial growth is increased and the rate of growth of the gas-producing bacteria—the *colon* group—is also increased. Hence, with high temperatures increasing the bacterial population, and thereby limiting the period of usability of the milk, we see the relationship of temperatures and the high cost of bacteria.

These charts have been prepared from data published by the Dairy Research Station, Reading, England. When produced under satisfactory conditions the milk did not clot for some considerable time (see details of upper chart); there were few bacteria, and hence the period of usability of the milk was accordingly long. Only eight of the seventy-five samples contained bacteria of the *colon* group in 1 c.c.;

organisms of this group are suggestive of manurial contamination, or unclean methods, or high temperatures, or aged milk, or the sum total of these factors. The milks represented by the upper chart are of excellent quality.

From the lower chart it will be seen that the samples clotted in a much shorter time, and that the numbers of bacteria were greater. Out of sixty-nine samples, forty-nine contained bacteria of the colon group in 1 c.c. The period of usability of the milk here represented was considerably shortened; hence the relation between the numbers and the varieties of the bacteria, the time taken by milk to clot, and the 'period' of usability of the milk; i.e., the number of bacteria per c.c. multiplied by 302½ gives the number per pint.

FARMS AVERAGE CONDITIONS

AGE	ON ARRIVAL IN LAB.	3 HOURS	
TEMP		66° - 85° F.	
		60° - 68° F.	1-2 DAYS
NO CLOT		56° - 59° F.	1-3 "
		ICE - CHEST	6 " (AVE)
		18 OF 69 SAMPLES OVER 200,000 PER CC	
BACTERIA		27 " 69 - 10,000-200,000	" "
		24 " 69 - UNDER 10,000	" "
COLON		49 " 69 - LACTOSE POS.	

The influence of temperature has also been demonstrated by Stocking, of Cornell. He took duplicate samples of the same milk. One portion held at 40° Fahr. for twelve hours contained 9,000 bacteria per c.c. and took seventy-five hours to clot.

The other portion held at 80° Fahr. for twelve hours contained 55,000,000 bacteria per c.c. and took twenty-eight hours to clot. The temperature influenced the rapid multiplication of bacteria and limited the length of period of usability of the milk.

With assistance I am conducting experiments throughout our own Province in the hope that we shall have data secured under local conditions. On one farm Miss Mounce and I have found that milk from the mixed herd took seventeen hours to clot at 98½° Fahr.—an average of a series of observations. At ordinary room temperature these milks would have taken from thirty to forty hours to clot. Delépine, in Manchester, has found that milk should keep perfectly sweet for twenty hours at 80° Fahr. The variation in time taken to clot is due in these cases to the variation in numbers and types of bacteria present.

Again, the using of unsterilized utensils and receptacles—utensils and receptacles which have not been steamed to kill the bacteria—lessens the period of usability of the milk. Delépine, of Manchester, has drawn milk into sterile bottles and into the usual farm utensils respectively. In the former he found 100 bacteria per c.c. and in the latter 4,300 bacteria per c.c. The former contained 800 bacteria per c.c. and was still sweet twenty-three hours later; the latter contained 230,000,000 bacteria per c.c. and had clotted. The milk here referred to was from the same group of cows, milked by the same milkers, at the same time, under the same conditions.

The differences shown were entirely due to the utensils. The length of time this period of usability is lessened is directly responsible for loss in dollars and cents and loss in food. It should further be remembered that every householder and consumer shoulders a grave responsibility wherever the care and control of milk is involved.

For unless the care and control is intelligent and thorough, the individual consumer must expect to suffer from and pay the penalty for the high cost of bacteria.

We are sometimes questioned as to the feasibility of using the count of bacteria in determining the hygienic quality of the milk. Total numbers of bacteria give us much information. Before we can fully interpret these numbers, however, we should know not only the total number of bacteria, but something of the varieties present, something of the conditions under which the milk has been produced and handled, the age of the milk, and the temperature at which that milk has been held since it was produced. If the information here intimated be taken into consideration, I am firmly convinced of the desirability of finding the count of bacteria for the purpose of interpreting the hygienic quality of milk.

Let us consider butter for a few moments. Some few months ago a large consignment of imported butter arrived in the City of Vancouver. This butter had been graded in the highest class, and rightly so. Deterioration had, however, set in, and I was asked to find, if possible, the cause of such. With my assistant, Mr. Vollum, I have been engaged upon the problem, and the data accumulated up to the present is sufficient to warrant us in saying that the deterioration is the result of the action of certain strains of bacteria. The butter is still, of course, marketable, but its value has decreased to the extent of several cents per pound. The manufacturer of this butter and the community at large have paid the price for the bacteria; and even on one car-load of butter the price thus paid is high. A few days ago the finest Prairie butter was selling at 73 cents and 72 cents per pound on the wholesale market. Dairy butter was listed at 60 cents per pound. This difference of 12 to 13 cents per pound is largely the result of failure to eliminate and control the bacterial population of the cream used for the making of the butter. The maker of the butter sold at 60 cents per pound is a victim of the high cost of bacteria.

Mr. President and gentlemen, just one word more. Those of us who for a longer or a shorter time have been engaged in an attempt to accumulate data relating to the hygienic qualities of milk have undoubtedly, in many different Provinces and in many different countries, found milk with a bacterial population of anything from a few thousands per cubic centimetre to many millions per cubic centimetre. Does it seem just that the man who produces a milk with a few thousand bacteria per c.c. should receive exactly the same price per pound of butter-fat for his milk as the man who produces and sells a milk with many millions per c.c.? Is it not largely for the man who sells milk plus bacteria that the expense of inspection is necessitated, and that the most expensive machinery is necessitated in order that the milk shall be purveyed to the public in a condition such that they may with safety consume the same? Is it not largely for such that cold storage must be insisted upon? Does it not seem that the time has come for the man who keeps out the bacteria to be paid for his care and management in so doing, just as he is paid for his capability, and faculty when it comes to a question of breeding in the butter-fat? Should not the man who produces a milk which by reason of its low bacterial population has a long period of usability be paid more per pound for butter-fat than the man who sends in milk having a limited period of usability?

Already the producer of milk is paid to breed in the butter-fat, and to keep out the bacteria.

A small Membership Fee to the B.C. Dairymen's Association secures for you your choice of "Hoard's Dairymen" or "Farm and Dairy" for one year, all reports and publications of the Association, and assists in educational work such as the publication of this pamphlet.

J. W. BERRY, President,
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